ICYNENE CORP.

Testimony of John J. Loyer
Program Manager, Government Affairs
Icynene Corp.

Delivered on June 13, 2007

Before The Michigan House Energy and Technology Committee

Representative Frank Accavitti, Jr., Committee Chairman

Thank you Mr. Chairman and members of the House Energy and Technology Committee, my name is John Loyer and I am Manager of Government Affairs for Icynene Corp., one of the largest manufacturers of open celled foam insulation in the world. Our company's U.S. headquarters is in Buffalo, NY, our world headquarters is located in Toronto, Ontario, Canada, and our insulation product is used on virtually every continent in the world in homes and buildings. The Icynene Insulation System® fills any shaped wall cavity and it adheres to almost all materials, forming an insulation layer with very low air-permeance. Airflow is eliminated and for this reason, conductive heat loss can be used as a sole criterion for establishing insulation thickness with Icynene®. We would like to take this opportunity to thank you for hearing us today.

Icynene® is a Preferred Insulation Product in Michigan

Icynene counts the state of Michigan, its builders and regulators as one of our most preferred states to promote the use of our product. Our insulation product receives more than fair treatment under the existing Michigan Uniform Energy Code (MUEC) from the Michigan Department of Consumer and Industry Services. The Department recognizes the benefits of our product and allows the use of Icynene to achieve a higher equivalent R-value (R-value is the conductive heat flow resistance of material) as a direct result of our material's superior energy efficient properties.

I am including the Department's letter mentioned above as part of our written statement and as evidence that Icynene would be adversely affected if the state of Michigan chose to adopt another energy code, such as the 2004 supplement to the 2003 International Energy Conservation Code (IECC) {see addendum #1}.

The IECC – A Code Not Based On Life Safety, But in Economics

Before I outline why the 2004 IECC supplement is such an abomination of the code development process, allow me to outline for you the reality of how the code process works for the IECC, which is a code not based in life-safety but in economics. The International Code Council (ICC), whose purpose as an organization is to promulgate and promote the codes that its membership votes to create, publishes the IECC triennially.

Every 18 months, the ICC membership meets (in 2 cycles) to determine what the requirements will be for the next triennial version of the all its codes. In a perfect world, the smartest minds in the various fields of construction would come together to accomplish this important and noble task. However, in a code that is not based in life safety, industry groups, trade associations, and special interests have become extremely adept at manipulating the development process to their particular interest's advantage. If one group is successful at obtaining code approval for their product's capabilities or characteristics (disguised in a simple code change proposal), it not only is the cheapest marketing money could buy, but in essence it could crush competition within a given product category.

The more powerful the advocate, and the more money thrown to try to sway the IECC committee, the more one group may prevail in gaining industry advantage over their competitors. There have been instances, as recently as the last cycle, where IECC committee members have taken funding from one industry group and not recused themselves when hearing and voting on a proposal that would negatively affect that group's competitors.

For example, the National Fenestration Rating Council (NFRC) hired two IECC Committee members, who also happen to be members of the NFRC Board of Directors, to promote a window standard published by NFRC and referenced in the IECC. When the American Architectural Manufacturers Association (AAMA) wrote an alternative standard and tried to get it accepted in the IECC, the two IECC committee members did not identify their conflict of interest nor recuse themselves for the vote, even when challenged from the floor to do so. Shockingly, the alternate standard was turned down by the IECC committee by very narrow margin of votes. This is just one example, but is indicative of how the IECC, which again, is not a life safety code, but one of economic impact, may be used to gain industry advantage.

While Icynene participates vigorously in the code development process, as a matter of corporate policy, we do not propose code changes without the buy-in and support of our competitors, as evidenced by our close relationship with the Cellulose insulation manufacturers represented here today and nationwide. One might ask oneself why the fiberglass industry is not counted as an industry ally to our company, nor does its trade association, The North American Insulation Manufacturers Association (NAIMA) represent any type of insulation OTHER than fiberglass. {see addendum #2 – NAIMA Letter}. Allow me to give you an example as to why the fiberglass industry does not collaborate with its competitors, and the reason why the 2004 IECC supplement should never be adopted as an energy code.

U.S. Dept. of Energy Built Consensus on 2004 RICC

The U.S. Department of Energy (DOE), the nation's chief regulatory agency for energy code development, drafted the 2004 Residential IECC Code Change (RICC) to simplify and modernize the International Energy Conservation Code (IECC). Included in the RICC were R-13 and R-19 default minimum values for wood framed walls and U-factor tables for prescriptive and performance compliance with the code.

DOE conducted extensive outreach out to companies, industry leaders, trade associations, and energy advocacy groups to achieve a broad consensus on the 2004 RICC. Included in the outreach were window, insulation, and energy experts, National Association of Home Builders (NAHB), NAIMA, American Council for an Energy Efficient Economy (ACEEE), Alliance to Save Energy (ASE), etc.

The RICC seemed to be on a fast track with unanimous buy-in of the entire residential construction industry; that is before the roof caved in.

Consensus Turns To Conflict - Fiberglass Attempts Proprietary Code Change

At the 11th hour, representatives of the fiberglass industry, its trade association NAIMA and NAIMA's heavily funded group, The Responsible Energy Codes Alliance (RECA) and its member The Midwest Energy Efficiency Alliance (MEEA), which all originally supported the 2004 RICC, unexpectedly announced their opposition to the R-13 and R-19 values, countering with its R-15 and R-21 proposal.

In Michigan, the Midwest Energy Efficiency Alliance (MEEA) promotes itself – according the group's Web site – "as the leading source and champion for advancing sound energy efficiency policies, programs and priorities to stretch these essential resources." However, MEEA support for energy efficiency policies are far from sound. In fact, their positions are rooted in its Board of Directors and list of members, which include the North American Insulation Manufacturers Association, Alliance to Save Energy, American Council for an Energy Efficient Economy and a number of fiberglass industry companies. As a result, MEEA supports the R-15 and R-21 proposals, a position that is adversarial to the vast majority of Michigan's home building community, including builders and code officials. {see addendum #3 – Who Funds MEEA}.

Why the fiberglass industry proposed R-15 and R-21 values is simple; fiberglass is the only insulation industry that can achieve this value with single component insulation (a batt). Their proposal was and still is PROPRIETARY and would virtually eliminate other insulation types from the marketplace.

Unfortunately, despite the strenuous objections of the vast majority of the home building community and DOE, the IECC committee sent this proposal to the full ICC membership for a vote.

In section R104.11 of the ICC's International Residential Code (IRC), it explicitly states that codes shall not be used for industry advantage nor ban any product that is approved for use.

R104.11 Alternative materials, design and methods of construction and equipment.
The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code. Compliance with the specific performance-based provisions of the *International Codes* in lieu of specific requirements of this code shall also be permitted as an alternate.

The Construction Community Rejects Fiberglass R-Value Proposal

Throughout the 2004-2005 code development cycle and at the ICC final action hearings in Detroit, the construction community vehemently objected to the fiberglass industry's higher R-value proposal. More than 20 companies, trade associations, industry leaders and 15 code officials testified at the microphone against this higher R-value proposal.

A SUPER MAJORITY, approximately 82 percent, of code officials, including Michigan code officials, saw through the fiberglass industry's deceptive and proprietary efforts and voted to turn back the R-values to the original R-13 and R-19 proposal.

2004 IECC Supplement Published by ICC and funded by the Fiberglass Industry

After its defeat at the ICC Final Action hearings in Detroit, the fiberglass industry, through its heavily funded organizations RECA and MEEA, wrote a check to the ICC Foundation for the publication of the 2004 IECC supplement as a stand-alone document. Never in the history of the ICC had a supplement been published between cycles as a stand-alone code. Representatives of RECA then traveled around the country, along with other representatives of the fiberglass industry, to promote the adoption of the 2004 IECC supplement to various jurisdictions at the state and local levels. Perhaps this could be attributed to the higher r-values found in the supplement and not in the official version of the subsequently published code, the 2006 IECC.

The ICC has since changed its policy on the publication of supplements and will no longer allow industry funded groups to fund the publication of codes {see addendum #4 – RECA Pays for 04 IECC supplement}

Costs v. Benefits Do Not Support Higher R-Values

For 2" x 4" or 2" x 6" walls, R-15 and R-21 are NOT cost effective for home builders and home buyers. In fact, higher R-values contribute to dramatically higher construction costs.

Using these R-values, the vast majority of new homes would have to be built quite differently, in accordance with either the IBC (designed by an engineer or architect), utilizing high-density batts, using double sheathing or even worse, sheathed with foamboard only. A less appealing and certainly more expensive option would be to build the home with 2" x 6" walls.

High-density R-15 batts, designed for a 3.5" wall cavity, are not available in most parts of the country. If these batts were even available, they would cost almost twice as much as R-13 batts, according to a National Association of Homebuilders (NAHB) survey. In fact, R-15 batts are almost double the material from R-13 and would give the fiberglass industry a proprietary building code advantage.

Building codes are not meant to be proprietary. In this case, no other insulation product (spray foam, cellulose, etc…), other than fiberglass, can meet more than R-15 levels in 2" x 4" framing with single component insulation.

Energy Savings & Cost Savings Can Be Achieved Together

The energy savings payback for R-15, according to a DOE 2004 report, is extremely small compared to the initial cost of complying with the higher R-values. The report indicated that the payback period was 40 to 90 years with an annual energy savings of $10 to $15. DOE placed the upfront increase cost of $600 – $1350 per home {see addendum #5 – DOE Report).

Increasing the insulation thickness (R-value), which this higher R-value proposal really attempts, will nearly double the cost of construction, according to NAHB, and provide only a modest two percent increase in heat flow reduction. And the result: energy savings amounting to less than the price of one large pizza.

Many construction techniques exist that save much more energy. Air sealing and proper energy code enforcement provide a "bigger bang for your buck" in the thermal envelope.

An important lesson about R-values learned from DOE's National Weatherization Programs and Building America Program is that it is not the "be all and end all" of energy saving. For homebuilders and buyers, sealing the thermal envelope from air infiltration and exfiltration is the bigger "bang for your energy savings buck".

The Bottom Line – MI Uniform Energy Code is a Win-Win for Home Builders and Home Buyers

The Michigan Uniform Energy Code should be the prevailing code in Michigan. The 2004 IECC supplement is a "code", and I use the term loosely, based on economic impact and has no basis in cost effectiveness or life safety.

The 2004 IECC supplement, with the increased R-values (R-15 and R-21), will result in significant excess cost to build a home. Home builders will have to pay more out-of-pocket to meet these proprietary R-values, increasing their and the home buyer's financial burden. Higher prescriptive R-values radically alter the playing field for cavity insulations, like Icynene® or cellulose, ensuring that the building code is improperly used as proprietary to fiberglass or their other products, like insulated sheathing.

And who stands to gain from this; the fiberglass insulation industry, that's who. {see addendum #6 – The Economic Thickness of Insulation}

The state of Michigan should stay the course with regard to its energy code because it benefits home builders, home buyers and the environment. Mr. Chairman, thank you again for providing me the opportunity to testify on behalf of Icynene and I will be happy to answer any questions.

JENNIFER M. GRANHOLM
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF CONSUMER & INDUSTRY SERVICES
LANSING

DAVID C. HOLLISTER
DIRECTOR

September 4, 2003

Mr. Ken McDade
Seal Tech Insulation
12501 Lake Pointe Pass
Belleville, Michigan 48111

Subject: Seal Tech Insulation
The Icynene Insulation System

Dear Mr. McDade:

I am writing in response to our recent meeting relative to the Icynene Insulation System's R-values. After thoroughly reviewing the product information you submitted, I have concluded where icynene insulation is installed to a minimum depth of 3.5" and where roof/ceiling insulation is installed to a minimum depth of 6" in accordance with manufacturer's installation instructions and the code, the Bureau of Construction Codes and Fire Safety will approve as an equivalent to an R-19 value and R-30 value, respectively, where specified in the Michigan Uniform Energy Code.

This approval is based upon the overall effectiveness of this product as demonstrated by the test results you have submitted, and authorized in accordance with Sections 104.11 of the Michigan Building and Residential Codes finding this product provides an equivalency to those prescribed by the code.

If you have any questions or concerns, feel free to contact me at (517) 241-9317.

Sincerely,

Larry J. Lehman, Chief
Building Division

LJL/bsc

cc: BCCFS Building and Plan Review Divisions

ICYNENE NU-WOOL ENGINEERED CELLULOSE INSULATION greenfiber COCOON

August 11, 2006

To whom it may concern:

This letter is written to inform you that as manufacturers of different types of insulation (cellulose and soft foam) and competitors in the marketplace, we are not represented by the North American Insulation Manufacturers Association (NAIMA), despite its name. Only fiberglass, rock wool and slag wool insulation manufacturers are permitted to belong as NAIMA members. We have all requested membership in the past, but have all been denied at various times. It is our intent to correct this misconception that NAIMA represents all North American insulation manufacturers and to make sure that you know that NAIMA's activities are not supported or encouraged by soft foam or cellulose insulation manufacturers. We also want you to know that our insulation materials are fully code compliant, energy and resource efficient. We respect and wholeheartedly encourage energy efficiency in this time of record high energy prices, as long as that efficiency is promoted for the right reasons, not just the profiteering of proprietary code changes that negatively affect the building industry as a whole.

Thanks for your time and consideration, and if you should have any questions, please do not hesitate to contact any of our respective companies listed here.

Gabe Farkas
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gfarkas@icynene.com

Mark Henderson
President
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IN SUPPORT OF BETTER BUILDING PERFORMANCE

ICYNENE CORP.

Information Taken from the Web site of the International Code Council Foundation (ICCF) (http://www.icc-foundation.org/news/RECA.html)

News Room

New Supplement makes it easy to reference energy code changes

A donation from the Responsible Energy Codes Alliance, Chairman Eric DeVito (right), to the International Code Council Foundation, Government Relations Senior Advisor Dave Conover, underwrote the distribution of the new International Energy Conservation Code 2004 Supplement to International Code Council governmental members. The publication updates all changes to the 2003 code and is suitable for adoption.

Code officials no longer need to carry a copy of the Accumulative Supplement to reference changes to the 2003 International Energy Conservation Code (IECC). The new IECC 2004 Supplement Edition puts the latest set of energy provisions published by the International Code Council in one document.

The International Code Council Foundation (ICCF) and Responsible Energy Codes Alliance (RECA) teamed up to create the publication. It makes it easier for code officials, design professionals and builders to apply energy conservation requirements to construct more energy efficient homes and buildings.

Revisions to the 2003 IECC during the code development cycle included eliminating four chapters (5, 6, 7 and 9) and the appendix. The new IECC 2004 Supplement, suitable for adoption by jurisdictions, incorporates all code changes to the 2003 IECC.

The Supplement was distributed free to International Code Council governmental members through a RECA donation to the ICCF. To purchase a copy of the International Energy Conservation Code 2004 Supplement Edition, click here or call 1-888-ICC-SAFE (422-7233).

The Economic Thickness of Thermal Insulation

The conventional method of evaluating the performance of insulation is to measure the R-value, the conductive heat flow resistance of the material.

The measurement of conductive heat flow resistance is made using the heat flow meter apparatus. This test procedure (ASTM C-518) measures the thermal conductivity of insulation material. In this test, one side of the specimen is heated to a specific temperature and after steady state heat flow has been reached, the temperature on the opposite side is measured. Through this temperature measurement the R-value is calculated. The outside surface of the test apparatus and the specimen is sealed and insulated to minimize the heat loss through the edge and eliminate the effects of any convection or radiant heat flow. This measurement solely defines the conductive heat flow resistance of the insulation material, the R-value.

Once the R-value of an insulation material is determined, the heat flow through it can be calculated using Fourier's steady-state heat flow equation.

$$Q = \frac{A \times \Delta T}{R}$$

Where:

Q = Rate of heat flow, BTU/hr
A = Area, ft^2
ΔT = Temperature differential, ° F
R = Resistance to heat flow, $hr.ft^2$ ° F/BTU

This equation is used to calculate the benefit of increasing the thickness of any type of insulation as long as there is no air movement (convective heat transfer) through the insulation.

As an example, consider 1000 ft^2 of insulated area with a temperature differential of 40°F. Let us include the outside air film at R-0.2 and the inside air film at R-0.7. The total R-value before the application of any insulation is 0.9. Increasing the insulation thickness by 1" increments at R-3.6/inch provides the following heat flow rates as shown in Figure 1.1 & 1.2.

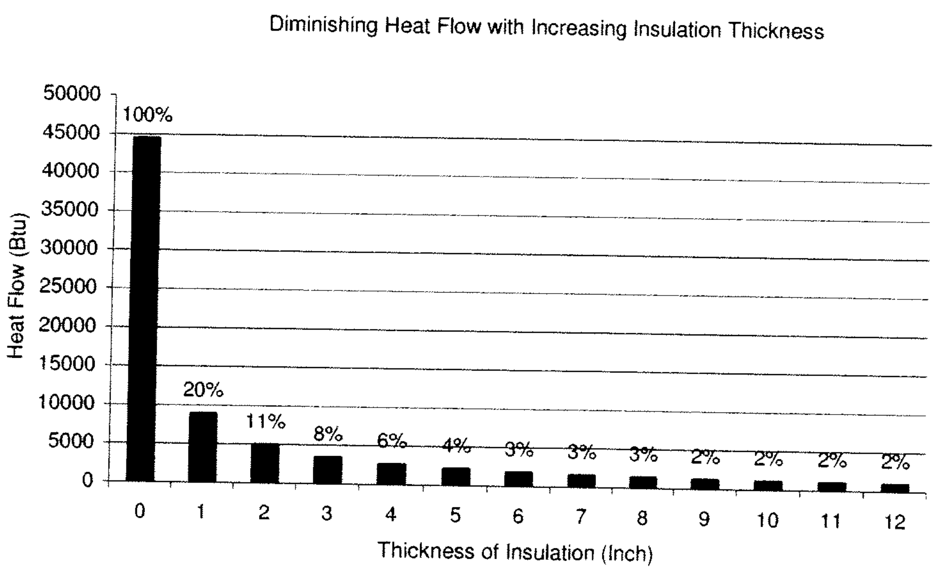

Figure 1.1: Percentage of total heat flow

Total Heat Flow Reduction with Increasing Insulation Thickness

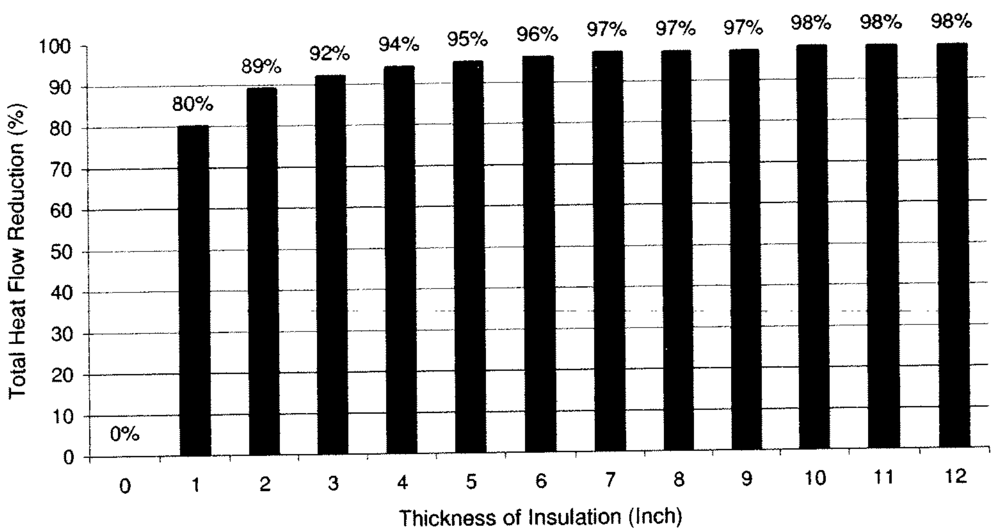

Figure 1.2: Percentage of total heat flow reduction

In Figure 1.1, we can see that the first 1" of insulation reduces the heat flow to 20% of the total and at 5" of thickness, the heat flow is reduced further, down to 5% of the total. In looking at Figure 1.2, we see that increasing the insulation thickness from 6" to 12" only provides an additional heat flow reduction of 2%. Doubling the insulation thickness (R-value); doubling the cost; only provides a modest 2% increase in heat flow reduction. Based on this observation, it is very difficult to justify the additional cost of adding insulation thickness beyond 5".

The Icynene Insulation System® fills any shaped cavity and adheres to almost all materials, thereby, forming an insulation layer with very low air permeance. Air flow is eliminated and for this reason, conductive heat loss can be used as a sole criterion for establishing insulation thickness with Icynene.

As shown in Figure 1.2, insulation material with R-value of 3.6 per inch blocks out 95% of conductive heat flow within the first 5 inches of the material. Thickness beyond this point would bring more reduction in heat flow but it would not be economically justified since the returns on additional R-value have greatly diminished.

REDUCE AIR INFILTRATION - REDUCE ENERGY USE REDUCE EQUIPMENT SIZE

In the case of insulation material with significant air permeance, conductive heat loss should not be the only criterion used for establishing insulation thickness. Convective heat loss must be considered as well, particularly when a substantial latent load is involved.

Oak Ridge National Laboratory (ORNL) conducted an experiment[1] to determine the efficiency of a roof assembly insulated with low density, loose-fill fiberglass insulation and discovered that up to 50% of the heat loss occurred as a result of convection; air circulation through the insulation. This result showed that the air-permeable insulation had lost its anticipated thermal performance level by half and that convective heat transfer had a significant negative impact on insulation performance.

[1] ORNL's Building Envelope Center: Fighting the Other Cold War
URL: http://www.ornl.gov/ORNLReview/rev26-2/text/usemain.html

The importance of reducing air infiltration can be easily demonstrated by analyzing the energy consumption for heating and cooling houses that have different R-values and air infiltration rates. The following evaluation was generated using the REM/Design energy analysis software. This evaluation deals with three identical houses, located in different North American cities with three different levels of insulation and air-infiltration. The house design is fully detached, has approximately 3,500 sq.ft. conditioned area with two stories and a fully conditioned basement.

The first is a **Typical** house with an air permeable insulation installed at R-19 in the walls & R-30 in the ceiling according to the general building code requirements and an air infiltration rate of 0.6 ACH at natural pressure.

The second house has the same insulation material with a **Higher R-value,** R-43 in the ceiling & R-19 in the walls and an air infiltration rate is kept at 0.6 ACH at natural pressure.

The third is an **Icynene** house with R-11 in the walls, R- 18 in the ceiling and an air infiltration of 0.1ACH at natural pressure.

Heating and cooling costs and the required heating and cooling equipment capacities for each house are plotted on the following graphs. The utility rates are set at $0.08 per kWh for electricity and $0.50 per Therm for natural gas.

Figure 2.1 shows the energy costs for heating in several different cities throughout North America. The heating costs are compared for the three different insulation systems. It can be seen that savings on heating cost reached up to 40%~50% with Icynene® when compared to the "**Typical**" and "**Higher R-Value**" insulation system. Also, the graph indicates that the colder the climate, the greater the heating cost savings are with Icynene.

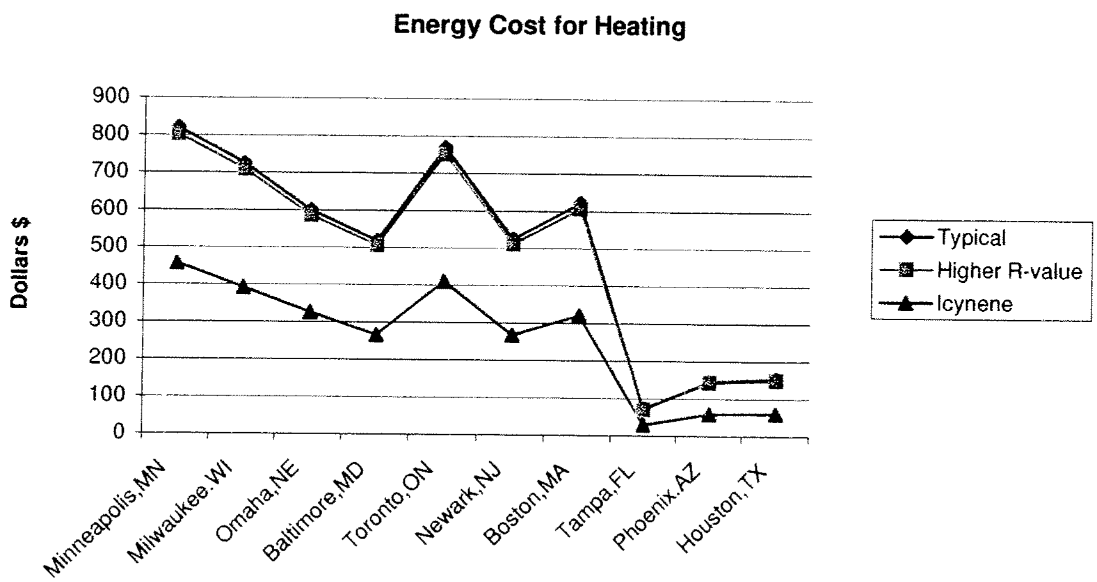

Figure 2.1

Figure 2.2 shows savings on cooling costs with Icynene. They provide savings of 25%~40% over the "**Typical**" and "**Higher R-Value**" insulation system. The cities in a hot & humid climate show greater savings due to the higher cooling demand and latent load.

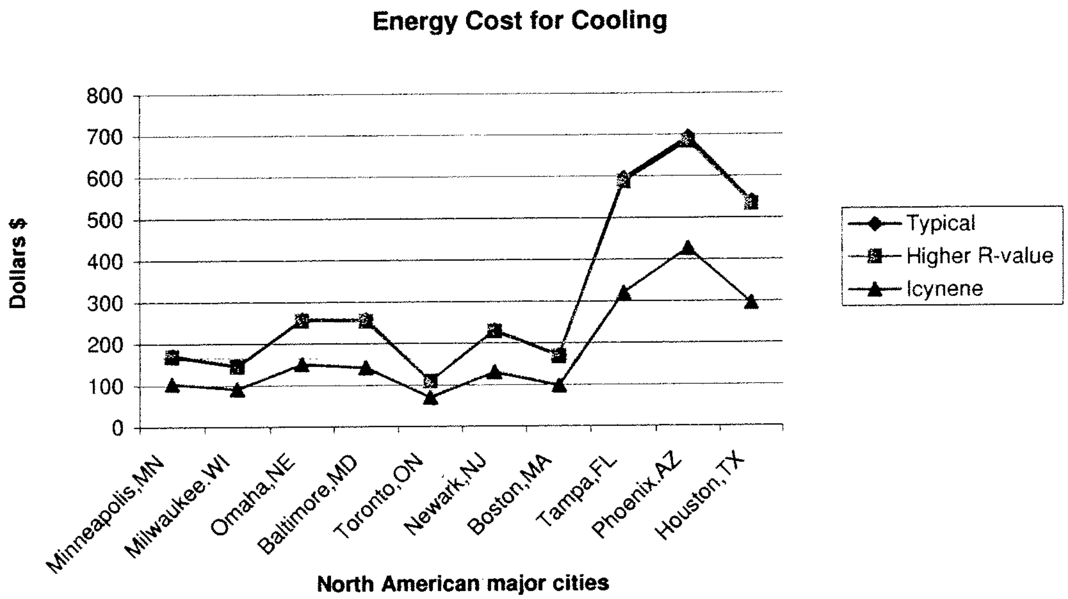

Figure 2.2

As far as sizing heating and cooling equipment is concerned, Icynene provides a significant reduction in both heating & cooling load due to its air sealing property. Figures 2.3 & 2.4 show the equipment size required in these houses for heating and cooling. The graphs show that there is a significant reduction in required capacity for both heating and cooling relative to **"Typical"** and **"Higher R-Value"** systems. Often with Icynene, size reduction for heating equipment can reach up to 50% and for cooling, it can be up to 40%.

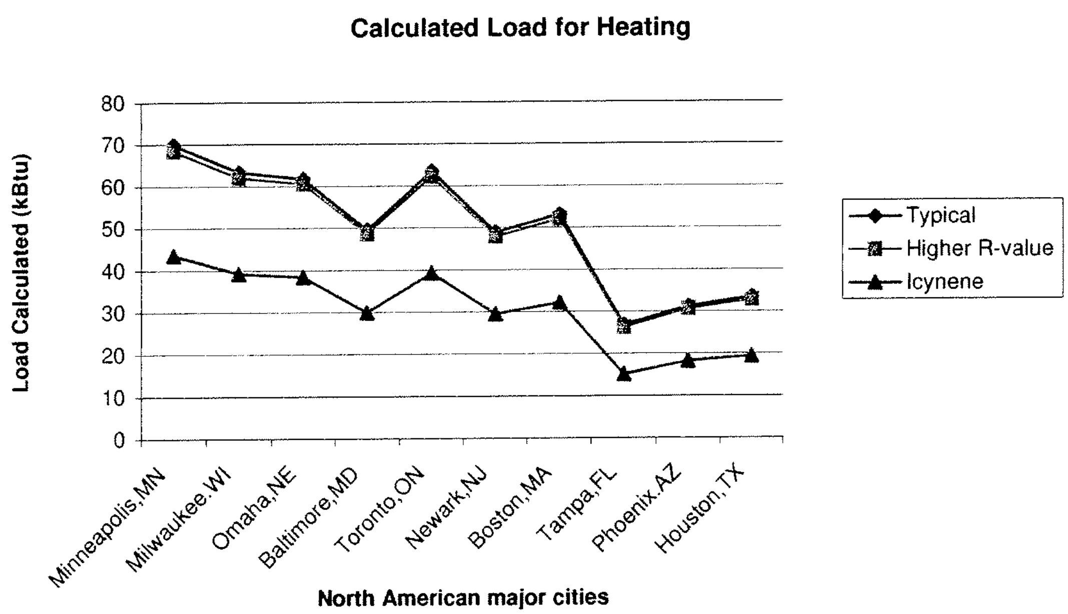

Figure 2.3

Calculated Load for Cooling

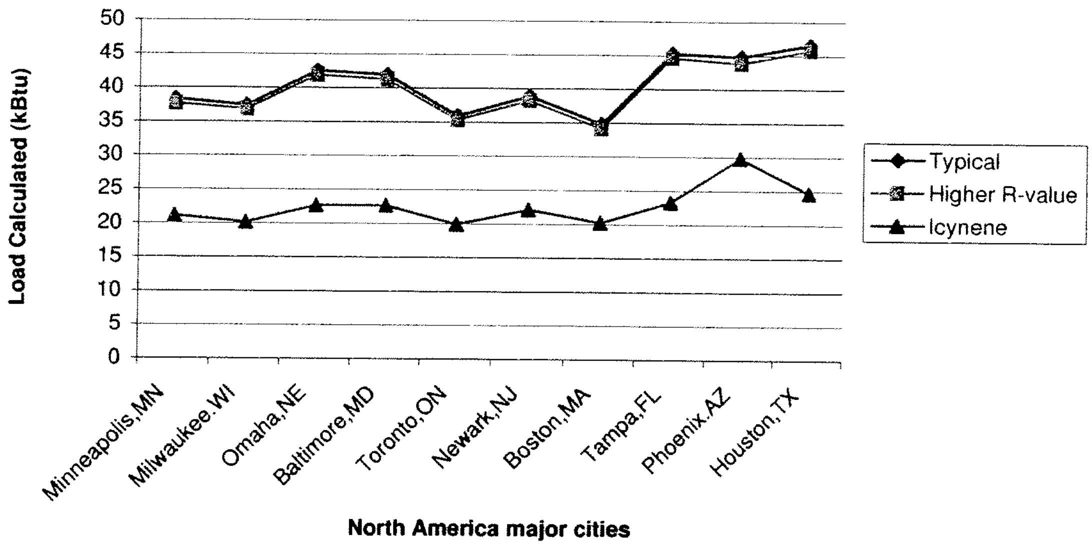

Figure 2.4

Icynene's air seal capability virtually eliminates convective heat transfer within the insulation and reduces unwanted air leakage through the building envelope. This feature improves the efficiency of the building envelope thereby reducing the heating and cooling costs and reducing the size of HVAC equipment as outlined in figures 2.1 through 2.4. As a result lower operating costs are realized and the cost of the operating equipment is reduced.

Often, air permeable insulation at twice the R-value gets used and still comes short of the desired energy savings as shown in Figures 2.1 and 2.2.

The on-site spray applied application of Icynene provides an excellent air seal that ensures a low air infiltration rate for the building envelope. This quality improves energy efficiency of the building as demonstrated through the graphs above and in addition, the overall performance of the building resulting in better sound attenuation, healthier indoor environment and enhanced thermal comfort.

An Analysis of Floor Modifications to IECC Code Change EC48-03/04

February 23, 2005

This report provides an analysis of several changes made to DOE's comprehensive Residential IECC Code-Change (RICC) proposal (EC48-03/04) that became the basis of the residential requirements in the 2004 Supplement to the 2003 IECC. The changes, proposed "from the floor" at the September, 2003, ICC hearings are hereafter called "floor modifications" or "floor mods." This analysis looks at the energy savings and incremental costs of two of the insulation and glazing floor mods as well as their possible impact on product markets and on the code's usability and enforceability. This report is intended only to serve as background data for DOE in assessing the potential impacts of the mods.

Executive Summary

DOE's "RICC" proposal made sweeping changes to the International Energy Conservation Code (IECC) designed to significantly improve its usability and enforceability. A number of modifications to the proposal raised "from the floor" at the September, 2003, Code Development Hearings of the International Code Council (ICC) changed aspects of the DOE RICC proposal. Many of the floor modifications were successfully inserted into DOE's proposal and subsequently approved by the ICC as part of the 2004 Supplement to the 2003 IECC. This reports analyzes two of the more notable floor modifications.

- **Wall R-values were increased**. In climate zones three through six, prescriptive wall cavity insulation requirements were increased from R-13 to R-15 (normally used in 2x4 walls) and from R-19 to R-21 (normally used in 2x6 walls).

- **Glazing trade-off limits**. Limits were imposed (or strengthened) on the maximum values of U-factor and SHGC permitted for glazing products. Unlike most other energy code requirements, these limits can never be exceeded, even if other compensating improvements (trade-offs) are made. The original RICC prohibited glazing U-factors, even in trade-off contexts, higher than 0.55 Btu/hr-sf-F in zones six through eight; the floor modifications lowered that value to 0.4 Btu/hr-sf-F and extended its application to zones four and five. The floor modifications also added an SHGC trade-off limit of 0.5 in zones one through three.

Wall R-value Increases

The **practical effect** of the wall cavity R-value increase was to increase the overall stringency of the thermal efficiency of the building envelope. While the use of R-15 and R-21 high density batt insulation seems to be the most straightforward prescriptive approach to achieving this increase, there are other methods to meet the R-15 and R-21 requirements. In order to avoid narrowing the list of products capable of meeting the prescriptive requirements, insulating sheathing is needed so that other cavity insulation types, including sprayed cellulose and expanding foams, can achieve the R-15 level (in 2x4 walls) or the R-21 level (in 2x6 walls). Use of these products will consequently require a builder to use a "trade-off" path to demonstrate compliance or will require the use of insulating sheathing in addition to structural sheathing and/or engineered cross bracing.

The **primary cost** associated with this floor modification is the cost difference between standard-density and high-density fiberglass batts or the costs associated using insulating sheathing instead of or in addition to other sheathing methods such as OSB sheathing. The incremental costs for the high density fiberglass products can be high in markets where these products are not commonly used—California data reports these at \$0.42 to \$0.44/ft^2. In Oregon, where the state code requires R-21, the incremental cost of this insulation level is reported at only \$0.10/ft^2. There may be little to no cost increase if insulating sheathing is used to obtain the additional R-2 requirement, but many builders prefer not to use insulating sheathing for reasons other than cost.

DOE calculated the **energy cost savings** resulting from this floor modification when fiberglass batts are used. A 2000-sf house was simulated using the DOE-2 energy simulation program in 239 U.S. locations. The calculated energy costs assume a gas price of \$0.90/therm and an electricity price of \$0.0947/kwh. Overall, the annual energy cost savings from the increased wall R-values average about \$15 per home, which amounts to 2% to 3% of HVAC energy costs.

Combining the increased costs and the energy savings of high density batt insulation allows an analysis of the **economic viability** of this floor modification. The simple payback period assuming the higher insulation data (from California) ranges from about 40 years in the northern affected zones to about 90 years in the southern zones. With the much lower Oregon insulation cost data, the simple payback is reduced to 9 to 21 years. Life-cycle cost (LCC—assuming a 50-year life, a 30-year mortgage with a 6% interest rate, a 6% nominal discount rate (3.3% real discount rate), and a 1% property tax) for the higher insulation levels are reduced if the lower insulation cost is assumed, but increase if insulation cost is at the higher estimate.

It is important to once again note that R-2 insulating sheathing can also be used to achieve the higher insulation requirements. However, as will be discussed later, that option involves additional considerations that complicate a direct cost comparison with the high-density batt option.

Glazing Trade-off Limits

The **primary effect** of the glazing trade-off limits is to set an absolute minimum (or maximum) value that can be used in a compliant home. For example, even if energy consumption is shown to be equal to or better than that resulting from the prescriptive code requirements, glazing products cannot be "traded down" beyond the limits. While this floor modification may ultimately result in energy savings, the trade-off limits clearly affect the market by instantly prohibiting products that would otherwise maintain market share interests and could be compliant within the original DOE RICC code change proposal if other energy efficiency measures within the building exceed code requirements.

The U-factor limit of 0.4 Btu/hr-sf-F has the effect of eliminating almost all types of aluminum windows and almost all windows that do not have low-emissivity coatings. The SHGC upper limit of 0.5 has the effect of eliminating almost all windows not containing low-emissivity coatings, tinting, or reflective glass. Since many homeowners may not want tinted or reflective glass, this is expected to lead to the use of low-E insulating glass virtually everywhere the code is adopted. The biggest impact of this limit will be to effectively eliminate single-pane glass, which is still common in Florida and pockets of the south near the Gulf Coast. In mild Zone 3 locations, most notably coastal California, the forced SHGC limit can actually raise energy costs because higher solar gains are advantageous in these chilly climates.

One tangible benefit of the SHGC trade-off limit is a potential **reduction in peak cooling loads** for homes that are otherwise energy-equivalent to a baseline code home. This could prevent a summer peak load increase of about 1 kW per house for certain trade-offs that increase the SHGC well above 0.50 (for example if the improvement allowing the SHGC trade-off is a high efficiency furnace).

Introduction and Background

This white paper summarizes an analysis of several modifications that were made to DOE's proposed (now accepted) rework of the International Energy Conservation Code (IECC). The modifications, proposed by motion "from the floor" at the 2003 Code Development Hearings of the International Code Council (ICC), were accepted by the IECC development committee.

Hereafter we will refer to DOE's change proposal as originally submitted to the ICC as the "original proposal" or, as dubbed during its development, the "RICC" (Residential IECC Code Change). The modifications proposed via floor motion at the Code Development hearings will be called the "floor modifications" or "floor mods." DOE's proposal as modified by the floor modifications will be called the "RICC as modified."

Two of the floor modifications have proven to be most notable among the parties interested in and affected by changes to the IECC. Although the RICC as modified is now officially part of the IECC (the 2004 Supplement), the Department has deemed it necessary to conduct an analysis of the floor modifications to assess the potential impacts of these mods.

A Description of DOE's "RICC" Proposal

The impetus for the original RICC was the frequently-heard comment that the IECC was too complex, hard to understand, and difficult to implement. Having worked for many years on development of energy-efficiency codes and standards, DOE in the mid-1990's added a compliance emphasis to its activities. DOE learned during the last decade of promoting energy codes and developing and deploying code compliance tools is that the energy-saving potential of the IECC was not being fully realized because of the difficulties in understanding, using, and enforcing the code.

A second impetus for the RICC was the common complaint that the IECC was not structured to adequately accommodate the concerns of cooling-dominated climates.

DOE's RICC addressed these two concerns in ways too numerous to discuss here. However, the bulk of the changes can be summarized in two primary characteristics of the RICC:

1. The climate basis for the IECC's requirements was changed from heating degree-days (HDD) to explicit geographic zones designed to align with county boundaries. As shown in Figure 1, there are eight temperature-oriented zones crossed with three moisture regimes (although not all 24 combinations exist in the U.S.).
2. The IECC's envelope requirements were made independent of window area percentage. In all previous versions of the IECC the minimum insulating requirements for walls and windows varied depending on the fraction of the gross wall area comprised of glazing.

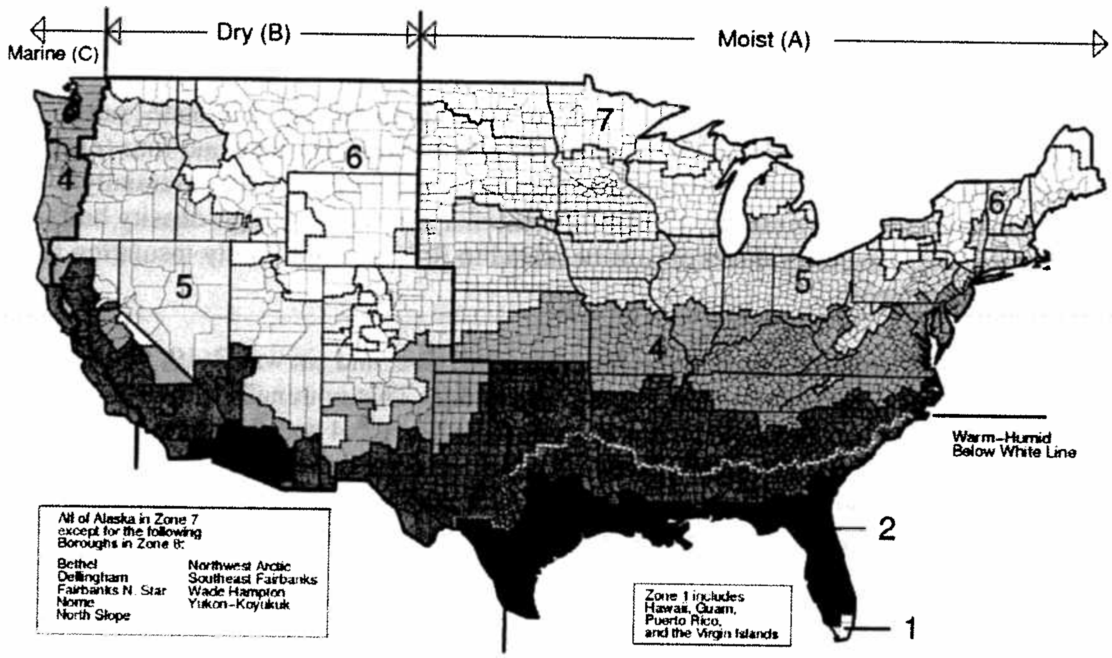

Figure 1 – New Climate Zones in the 2004 Supplement to the 2003 IECC

So that the Department could focus on usability issues without introducing other controversies, the specific envelope requirements of the RICC were designed to result in essentially no change in the code's overall stringency, averaged over all homes. Thus we say the original RICC was "energy neutral" on average. Obviously, some homes (e.g., high window-percentage homes) can be somewhat less efficient under the RICC while others (e.g., low window-percentage homes) will be somewhat more efficient.

The Floor Modifications

In the ICC's Code Development Hearings, minor modifications to submitted change proposals are permitted by motion from the floor. A number of floor motions affecting the RICC were accepted by the IECC committee. Several of those were substantive (as opposed to editorial), technically changing DOE's original proposal. Two floor modifications that noticeably affected stringency or usability are discussed in this paper.

Two primary floor modifications are of interest:

1. The minimum allowable R-values for wall insulation were increased in some zones, and
2. The trade-off limit for glazing U-factors was made more strict and a Solar Heat

Gain Coefficients (SHGC) limit was added

These are discussed in more detail below.

Wall R-value Increases

The floor modifications of interest increased the R-value minimums in climate zones three through six. The RICC's wall R-value requirement in zones three and four (except Marine) was R-13. The floor modifications increased that to R-15. This essentially corresponds to changing a standard fiberglass batt in a 2x4 wall to a high-density batt. Alternately, R-2 insulating sheathing can be added to R-13 framing cavity insulation to meet the requirement.

The RICC's wall requirement in zones four (Marine), five, and six was R-19, with an option of using R-13 between studs plus R-5 sheathing. That nominally allowed a standard fiberglass batt in a 2x6 wall or a standard batt in a 2x4 wall with insulating sheathing. The floor modifications increased those requirements to R-21 in a 2x6 wall or R-15 in a 2x4 wall with R-5 insulating sheathing. Again, the difference is nominally a switch from standard fiberglass batts to high-density batts or the addition of R-2 insulating sheathing.

These changes are summarized in Table 1.

Table 1 – Summary of Wall-R Changes Due to Floor Modifications

Climate Zone	*Minimum Wood-Frame Wall R-value*
1	13
2	13
3	~~13~~15
4 except Marine	~~13~~15
Marine 4 and 5	~~19~~21 or ~~13~~15+5
6	~~19~~21 or ~~13~~15+5
7 and 8	21

The floor modifications have the effect of requiring insulating wall sheathing in the prescriptive compliance path if non-fiberglass products are used for the cavity insulation. The two prominent examples are cellulose and expanding foam, both of which can meet the R-13/R-19 requirement in 2x4/2x6 walls, respectively, but cannot achieve the R-15/R-21 levels without increasing the stud thickness.

Glazing Trade-off Limits

The RICC included a trade-off limit on glazing U-factor that disallowed windows with a U-factor exceeding 0.55 Btu/hr-ft^2-F in zones six through eight. This provision was intended to prohibit the use of "very inefficient" glazing products even if the energy losses were made up elsewhere in a home, the intent being to avoid moisture condensation and comfort problems (cold spots) in northern climates. The floor modifications lowered the U-factor limit to 0.4 Btu/hr-ft^2-F and extended its applicability to zones four and five as well.

Additionally, the floor modifications added an SHGC trade-off limit (maximum) of 0.5 for windows in zones one through three. Both the U-factor and SHGC trade-off limits apply to the whole-house average, not to individual windows/skylights/doors.

Approach

This analysis focuses on the floor modifications from two angles. First, we calculate the energy and cost impacts of the changes and estimate the differences in life-cycle costs to consumers. Second, we evaluate any significant factors that might impact the usability or enforceability of the code, thereby impacting the number of states willing to adopt it or the number of homes that will actually comply. The latter viewpoint necessarily involves some subjective assessments. These are deemed important because the original purpose of the RICC was not to increase its stringency but to produce a code that would result in more homes actually achieving compliance. Also, because of DOE's usability focus in preparing the RICC, a number of external reviewers were surprised by the floor modifications and have demanded that DOE publish an analysis of those changes.

Energy impact analyses for the wall R-value increases were conducted with the DOE-2 energy simulation program. Energy impacts for the trade-off limits are, by definition, zero. However, we do present some limited assessments of secondary impacts that may impact energy use, again often using somewhat subjective approaches.

Analysis and Discussion

Wall R-value Increases

Energy Efficiency

The wall R-value increases have a straightforward impact on energy efficiency. The new R-values clearly increase the required insulating properties of walls, which results in an improvement in the overall efficiency of a home. Accounting for this improvement in terms of annual energy costs, the wall R-value floor mods result in an energy savings of between 2% and 3% of HVAC (1% to 2% of total) energy costs.

Energy savings estimates for the wall R-value increases are straightforward to generate. Our wall R-value analysis involved hour-by-hour annual energy simulations of a 2000 ft^2 two-story house on a crawlspace foundation. Simulations were run for each of the 239 available TMY2 weather files (although for many locations there is nothing to analyze because the floor modifications affected only zones three through six). The efficiencies of other house components were set equal to the minimum requirements of the 2004 Supplement. Wall insulation was assumed to be fiberglass batt insulation (no insulating sheathing). The effective insulating value of R-19 insulation was assumed to be R-17.8 because R-19 fiberglass batts must be compressed to fit into the cavity left by 2x6 framing.

The major assumptions used in the energy simulations are shown in Table 2.

Table 2. Assumptions in Simulation Analysis of Floor Modifications

Simulation model	DOE-2.1E
House design and size	2-story, 40x25 ft., 2000 ft^2 conditioned floor area
Wall area (excluding windows and doors)	1878 ft^2
HVAC system type	Natural gas furnace, 78% AFUE; 13 SEER
Fuel prices	\$0.90 per therm[a], 9.47 cents per kWh[b]. 2.6% inflation rate[c].
Climate Cities	239 TMY2 weather data locations
Aggregation method	City-by-city results weighted by year-2000 housing starts
Wall Construction	Wood frame, 23% framing by area[d]

a. \$0.85/therm is the average long-term "reference case" residential rate for 2005 through 2025 in real 2003 dollars from the 2005 Annual Energy Outlook. This was escalated to \$0.90/therm to account for inflation from 2003 to 2005. http://www.eia.doe.gov/oiaf/aeo/aeoref_tab.html (Table 3)
b. Residential average for August 2004. Source is Electric Power Monthly: http://tonto.eia.doe.gov/ftproot/electricity/epm/02260411.pdf
c. http://www.eia.doe.gov/oiaf/aeo/pdf/aeotab_19.pdf
d. R-19 is assumed to have an effective R-value of 17.8 because of compression. http://www.energy.ca.gov/title24/residential_manual/res_manual_chapter2.PDF

The resulting energy cost savings are shown in Figure 2.

Annual Energy Cost Savings ($) from Increased Wall Insulation

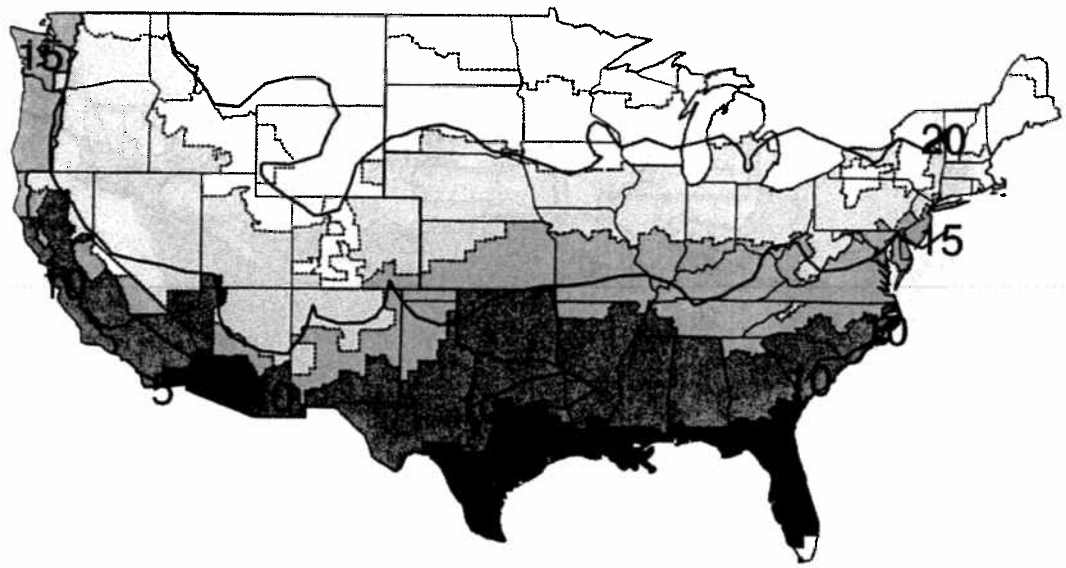

Figure 2 – Annual Energy Cost Savings ($) from Wall-R-Value Increases

Note that annual energy cost savings of the wall R-value increases peak at about $20 in the coldest locations and are between $10 and $15 in most of the U.S. Recall that these savings numbers are for a 2000 ft^2 home. Figure 3 shows the same results as a *percentage* of total annual HVAC costs. For most of the country the energy savings are near 2.5% of HVAC costs.

Percent Energy Cost Savings from Increased Wall Insulation

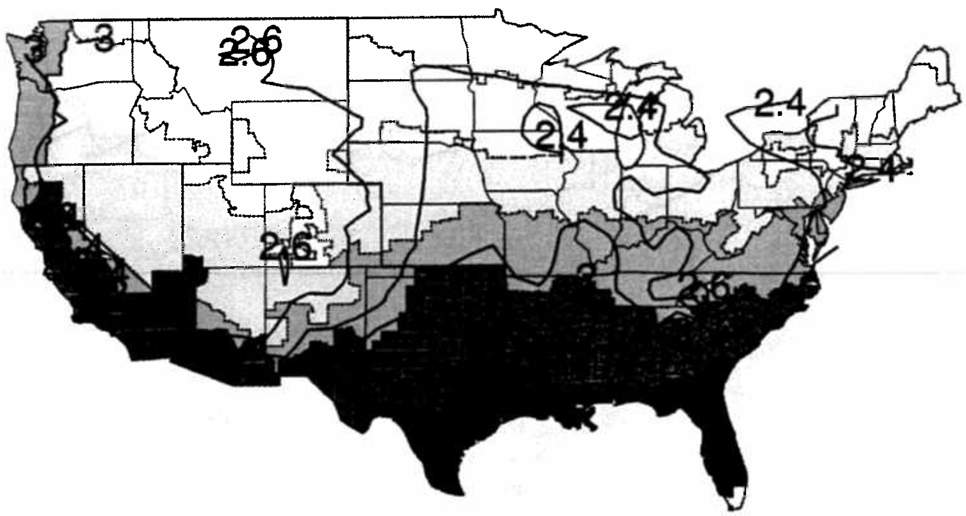

Figure 3 – Annual Energy Cost Savings (as a percentage of HVAC costs) from Wall-R-Value Increases

Measure Costs and Life-Cycle Costs

Addition of R-2 Insulating sheathing

The R-15 and R-21 wall insulation requirements, respectively, can be met with R-13 and R-19 cavity insulation and the addition of R-2 insulating sheathing. Common types of insulating sheathing are polystyrene (either extruded or expanded) and polyisocyanurate. Using extruded polystyrene as an example, insulating sheathing about ½" thick would have to be added to a standard R-13 or R-19 wall to achieve the R15/R21 levels. However, assessing the pros and cons of insulating sheathing as the assumed method of meeting code is complicated because of the variety of factors involved.

Insulating sheathing can often replace other types of sheathing such as OSB or plywood, provided another means of shear bracing is used (this is discussed further below). So a meaningful cost comparison must account for engineered bracing costs, additional skilled labor costs as well as material costs. R.S. Means reports that the total *installed* cost of insulating sheathing is less than that of plywood. Half-inch plywood costs $\$1.15/ft^2$ while a full inch of extruded polystyrene costs $\$0.83/ft^2$. A "Toolbase Technote" from the NAHB Research Center reports the *material* cost of insulating sheathing at about half that of OSB or plywood. Neither of these estimates includes the engineering costs or the additional bracing costs. The use of insulating sheathing in lieu of plywood or OSB can sometimes eliminate the need for an air infiltration barrier ("housewrap") if the joints are properly taped and sealed, as has been demonstrated by DOE's Building America program [Home Energy Magazine 1999]. Insulating sheathing may help prevent moisture condensation in walls by raising the temperatures within the walls and providing a drainage plane, depending on climate and other wall construction details.

Though insulating sheathing has some clear advantages over other sheathing materials, there are drawbacks as well, such as the need for bracing. Shear bracing requirements differ depending on the house type (e.g., one- vs two-story), location (e.g., earthquake and high-wind regions), and design details (e.g., locations of windows and doors). We know empirically that most builders choose not to use insulating sheathing [NAHB Builder Practices Reports, www.nahbrc.org]. Other reasons for this may include a perception of less security (from the lack of a "solid" wall barrier) and the absence of a helpful nailing surface for nails that "miss" the studs. Alternative techniques—such as using one-inch foam sheathing except at building corners where half-inch plywood sandwiched with half-inch foam is used—can resolve some of the issues, but the result has a higher R-value than the R15/R21 target, making cost comparisons difficult. (See the article by Paul Frisette in the web link below for an overview of many of these issues.)

Source:

Home Energy Magazine Online. January/February 1999. *Builders Find New Technologies Paying off.*
http://homeenergy.org/archive/hem.dis.anl.gov/eehem/99/990110.html
R.S. Means 2005 Residential Cost Data. Kingston, Massachusetts
National Association of Home Builders, Research Center. 2003. *Alternatives to Structural Plywood and OSB.*
http://www.toolbase.org/tertiaryT.asp?TrackID=&CategoryID=29&DocumentID=3984
Paul Fisette. 2004. *Insulating on the Outside.* University of Massachusetts
http://www.umass.edu/bmatwt/publications/articles/insulating_on_the_outside.html

R-15 and -R21 Fiberglass Batt Insulation

One method of meeting the higher wall R-value requirements is the use of high-density fiberglass batts in lieu of standard batts. However, establishing a confident and universally-applicable estimate of that cost is somewhat difficult. Because high-density batts are relatively uncommon in most areas there is a general lack of good information on marginal costs. The best information available to the Department comes from the California Database for Energy Efficient Resources (DEER) [Xenergy, Inc. 2001]. DOE searched for additional studies and made several requests of interested and affected parties for such information, but none was available at the time of this writing. A few anecdotal suggestions made to the Department were not used because they were unsubstantiated or deemed potentially biased.

California has a long history of tracking efficiency-measure costs and the DEER represents one of the most comprehensive and well-researched databases available. However, the present unpopularity of high-density batts raises the prospect of their costs going down should the national model code result in more widespread use of the high-density material. An example of such a transformed market is the state of Oregon, which has required R-21 in residential walls for some time. A somewhat dated study found the cost difference between R-19 and R-21 in Oregon to be $0.10/sf [Oikos 1994]. Although prices may have changed in the ten intervening years, it is unlikely that inflation would account for much of the four-fold difference between this estimate and DEER's. The remainder is likely attributable to regional price variations and market transformation effects.

The available cost estimates are summarized in Table 3. Note that the Department did not identify a similar transformed market for R-15 batts.

Table 3. Wall Insulation Cost Estimates

Source	Incremental Cost
R-13 to R-15	
California 2001 Database for Energy Efficient Resources	$0.42/ft^2
R-19 to R-21	
California 2001 Database for Energy Efficient Resources	$0.44/ft^2
Oregon 1993 Study (Energy Source Builder #34, August 1994)	$0.10/ft^2

Sources:

Oikos. 1994. Energy Source Builder. Iris Communications, Inc. Lorane, Oregon. http://oikos.com/esb/34/oregoncode.html

Xenergy. 2001. Database for Energy Efficient Resources Update Study: Final Report. Oakland, California. http://www.energy.ca.gov/deer/2001_DEER_Update_Study.PDF

We examined both the high (the California costs) and low (Oregon's $0.10 incremental cost) insulation cost scenarios to bracket the cost impacts. Given those cost estimates, Table 4 shows the simple payback periods (years) of the higher wall insulation levels resulting from the floor modifications by climate zone. Zone averages are the averages of the 239 cities weighted by the housing starts in 2000. At the high cost level the modifications are clearly very long-term investments, with paybacks approaching 100 years in the warmest zone and over 40 years in the colder climates. Payback was much faster with the lower insulation cost, ranging from 9 to 23 years.

Table 4. Simple Payback (years) for Increased Wall Insulation R-Values

	Simple Payback in Years	
Zone	High Insulation Cost	Low Insulation Cost
3	89	21
4	52	12
5	49	11
6	40	9

Assuming a 50-year life, a 30-year mortgage with a 6% interest rate, a 6% discount rate, 2.6% inflation, a 30% income tax rate, and a 1% property tax, we computed the change in life-cycle cost resulting from the floor modifications. These are shown in Table 5. The floor mods increase total costs in the high insulation cost scenario but save money in the low insulation cost scenario.

Table 5. Life-Cycle Cost Savings ($) for Increased Fiberglass Batt Wall R-Values

Zone	Life-Cycle Cost ($)	
	High Insulation Cost	Low Insulation Cost
3	-498	32
4	-400	131
5	-424	162
6	-352	233

Other Factors

As mentioned earlier the purpose of the RICC was not to increase the code's stringency but to achieve energy savings by improving the code's usability. It is therefore important to understand the impact of the floor modifications on the palatability of the code, the probability that it will be adopted by states, and the possibility of secondary impacts that might lower expected energy savings.

One issue of interest is the possibility that the R-15 and R-21 wall insulation requirements will result in a market disadvantage for wall insulation systems other than fiberglass batts. In particular, the Department has received data that, for example, wet-blown cellulose and expanding foam products cannot achieve similar R-values to high-density fiberglass batts but have the advantage of better sealing the wall cavity and hence reducing air infiltration. We reviewed several available studies to determine the magnitude of any such effect.

The Cellulose Insulation Manufacturer's Association website summarizes a 1989-90 study comparing fiberglass and cellulose in two otherwise identical test buildings. The study, which looked at both ceiling and wall insulation, concluded that cellulose can indeed result in a tighter house (36% to 38% tighter in the test buildings). A comparison of overall heat loss values showed improvements of about 26% for cellulose over fiberglass. DOE was not able to obtain a copy of the report on this study, however.

Source:

http://www.cellulose.org/cellulose_benefits.html

In contrast, the North American Insulation Manufacturers Association cites several studies that suggest a smaller infiltration reduction benefit or no benefit for wet-blown cellulose or expanding foam products, based chiefly on the observation that an otherwise well-sealed wall will see little or no benefit from different types of cavity insulation.

Sources:

Field Demonstration of Alternative Wall Insulation Products. Prepared for the U.S. Environmental Protection Agency by NAHB Research Center, Inc., November 1997.

A Field Study of the Effect of Insulation Types on the Air Tightness of Houses. G.K. Yuill, Ph.D., Pennsylvania State University Department of Architectural Engineering, 1996.

Research and Development Project, "Maple Acres," Union Electric, St. Louis, MO. William Conroy, Division Marketing Supervisor, 1995.

This review of available studies suggests that the insulation products may indeed affect infiltration through the wall but the magnitude of the benefit depends on how well-sealed the remainder of the wall is. In other words, if the interior and/or exterior finish is well sealed to framing, and penetrations are well-caulked or gasketed, the marginal benefit of an air-impervious insulation layer is small. Given the often-reported lack of quality control in air-sealing techniques, these insulation types may have some impact on air sealing. However, the available data for infiltration testing in actual houses is not extensive enough to verify or quantify the impacts of different wall insulation types.

Glazing Trade-off Limits

DOE's original RICC proposal included a hard upper bound on glazing U-factor—a limit beyond which no windows would be allowed, even in the context of a compliance trade-off against better features elsewhere in a house. This type of restriction differs from the minimums and maximums typical of most codes' provisions in that it effectively prohibits certain types of products without recourse—in the relevant region, those products are basically illegal.[1]

Energy Savings

By definition, a compliance trade-off is energy-neutral. Therefore, the direct energy impacts of the U-factor and SHGC trade-off limits imposed by the floor modifications are zero.

One indirect exception to this line of thinking relates to SHGC benefits (or lack thereof) in some mild climates. Our energy simulations suggest that in some relatively cool zone-three locations the prohibition of higher SHGC values can actually force a higher annual energy consumption because of increased heating loads. Although the number of locations and magnitudes involved are small, it is philosophically problematic for a code to mandate the higher-energy option.

There are other indirect or secondary impacts that may influence energy consumption. These impacts, which are uncertain and difficult to quantify, are discussed later.

Measure Costs and Life-Cycle Costs

As there is no direct increase in code stringency, the costs of measures related to these floor modifications are likewise zero. These measures may prevent trade-offs that could

[1] Actually, as structured in the 2004 Supplement, the "prohibited" products *can* be used as long as the area-weighted average U-factor (or SHGC) is not beyond the trade-off limit. This permits minor trade-offs to allow, for example, a decorative sidelite or a few small windows that are outside the trade-off bounds. It also permits, for example, half the windows to be worse than the trade-off limit if the other half are sufficiently better.

lower construction costs, however, preventing a builder from finding less costly ways to achieve equivalent energy consumption. But even in this context the costs are difficult or impossible to specify since many trade-offs are done to take advantage of local and/or short-term cost structures.

Secondary Energy Impacts and Other Considerations

Code-imposed trade-off limits require a stronger basis than do simple minimum/maximums that can be circumvented via trade-off. Strictly speaking, a trade-off limit saves no energy, so absent another compelling reason (safety, durability, etc.) it is difficult to justify such restrictions in an energy code.

DOE's intent for the fenestration U-factor trade-off limit in its original RICC proposal was two-fold.

First, placing an upper limit on the U-factor can prevent certain kinds of moisture failures. Specifically, windows with a too-high U-factor in northern locations can experience moisture condensation and even ice formation on the glazing and/or frame. Condensed moisture can find its way into walls where it lessens the effectiveness of insulation or compromises the integrity of the wall itself.

Moisture condensation on windows is a complex function of the indoor temperature and humidity and the outdoor temperature. A summary of the conditions under which condensation can be expected can be viewed at http://www.efficientwindows.org/condensation.cfm.

Second, limiting the installation of high-U-factor glazing can prevent comfort problems. Even if the overall UA of a house is maintained (thereby making a trade-off theoretically energy-neutral), "cold spots" on the exterior walls can make occupants uncomfortably cool because of radiative heat exchange. In the worst case, a too-low "mean radiant temperature" can influence occupants to raise thermostat setpoints, having a deleterious effect on energy consumption. However, there is insufficient research and data to permit reasonable estimation of either the average occurrence of discomfort due to high-U windows or the frequency of thermostat manipulation as a result. Given this lack of hard data, a U-factor of 0.55 was deemed by many parties consulted as a reasonable, but not overly stringent, limit.

Although DOE's original RICC proposal included no SHGC trade-off limits, DOE recognizes the potential rationale for such limits. First, limiting the installation of very-high SHGC windows in southern climates can prevent occupant discomfort from hot spots in the home, even when overall energy consumption is theoretically unaffected. When occupants experience too-warm rooms or radiant heat from solar-heated floors and walls, they may lower thermostat setpoints. However, DOE is unaware of research or data that would quantify this energy impact with sufficient confidence to justify a code restriction. Additionally, the trade-off limit does not credit alternative methods of solar heat control such as roof overhangs in lieu of low-SHGC glazing[2].

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[2] Overhangs are credited in the performance approach but the 0.5 SHGC glazing limit applies regardless of how much solar heat is blocked by the overhang.

Second, limiting the worst-case SHGC of homes in cooling climates can have a beneficial effect on peak loads. Even if a trade-off is energy-neutral, raising SHGC in trade for other improvements can result in higher peak loads in some cases. This can require larger air-conditioning units that will operate at lower part-load ratios for much of the year, indirectly raising energy consumption. Also, high peak loads are increasingly problematic for electric utilities. Although few residential electric customers pay directly for their impacts on peak loads, recent blackouts and brownouts in California and the Northeast have focused much attention on the possibility of billing residential customers for their impacts on system peak.

To evaluate the potential peak-load benefit of restricting SHGC trade-offs, DOE conducted energy simulations using the DOE-2 computer program for each of the available 239 TMY2 weather locations. The worst-case trade-off for peak loads is to reduce cooling-oriented envelope efficiency (i.e., increase SHGC) in trade for better heating performance (e.g., increased AFUE) in climates that have substantial heating. DOE evaluated the peak load impacts of trading the code-mandated 0.4 SHGC up to a hypothetical value of 0.65 and making up the difference with non-cooling-oriented changes. The results, shown in Figure 4, reveal a fairly consistent peak cooling load "potential" of about 1.5 kW resulting from this hypothetical SHGC trade-off. Specific load impacts will depend, of course, on actual window area and orientation (our simulations assume windows equally distributed in the four cardinal directions). Also, though we analyzed the impact of raising SHGC only to 0.65, it is conceivable that higher values could be attained using single-pane glass.

The floor modifications cap the SHGC at 0.5, eliminating a sizable fraction of the SHGC-induced peak load potential.

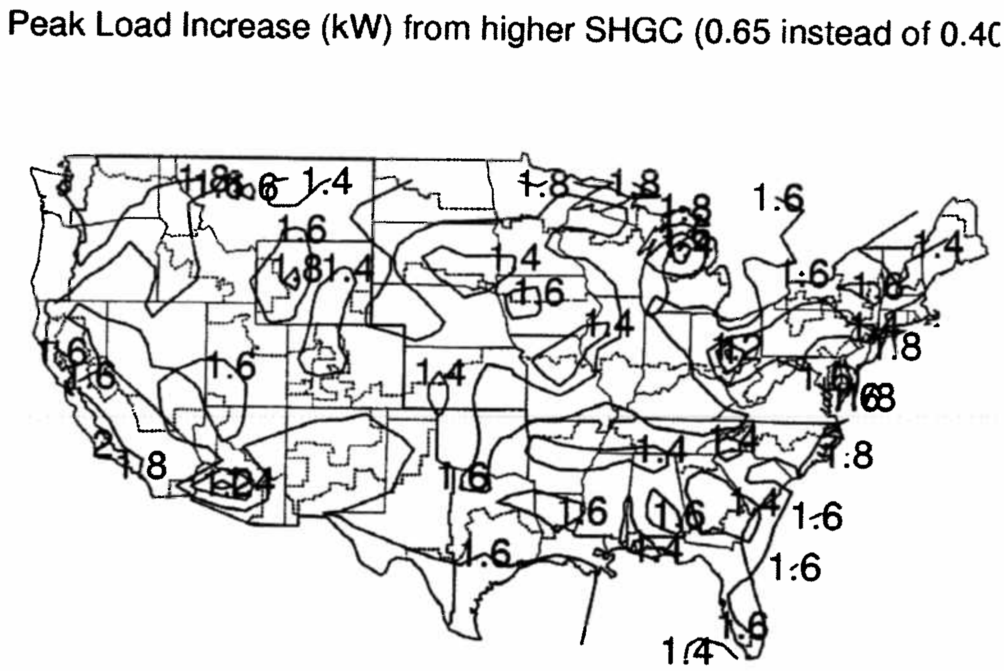

Figure 4 – Peak Load Increase (kW) from Raising SHGC from 0.4 to 0.65.

Market Influences

To assess the effect of the mods or product choices and options, the relatively simple trade-off limits imposed by the floor mods were evaluated against the range of window options available in the 2001 NFRC database (an electronic version of a more current database could not be obtained from NFRC).

Figure 5 shows the distribution of U-factor options in the NFRC database. Only double-pane options are included because single-pane options are rarely used in the northern tier states. The histogram clearly shows the bi-modal distribution of double-pane U-factors, the leftmost mode representing low-E glazing options and the right mode representing non-low-E options.

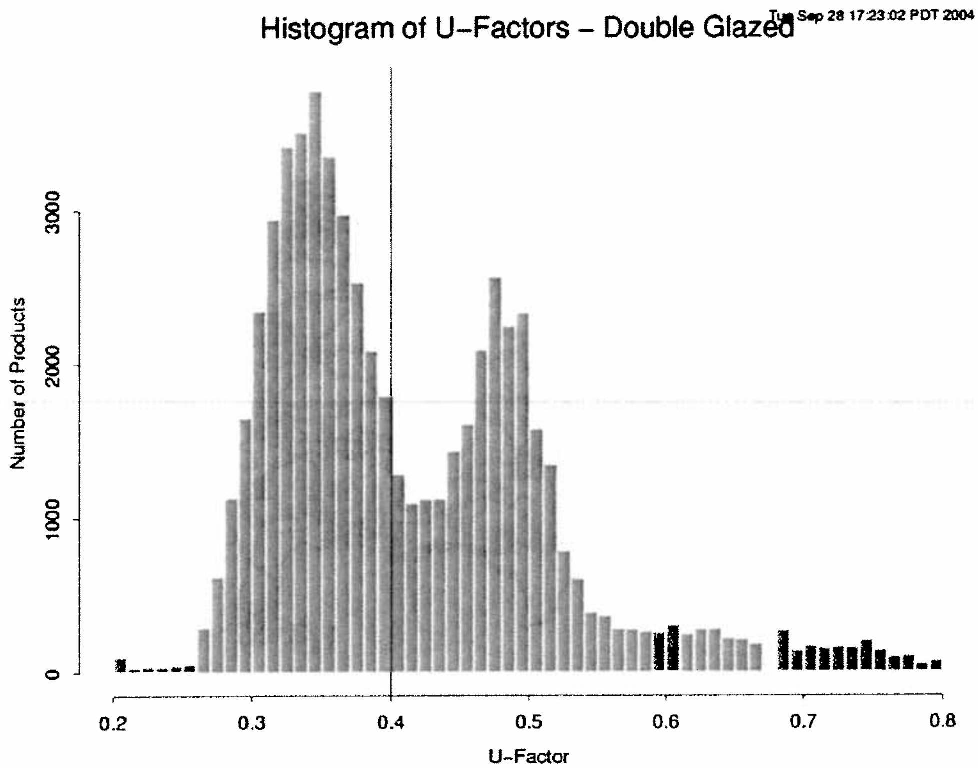

Figure 5 – Distribution of Rated U-Factors of Double-Pane Windows

Figure 6 shows the distribution of SHGC values among window options available in the NFRC database. This graphic includes both single- and double-pane units. Unlike the U-factor distribution, the SHGC distribution is single-mode, indicating no clear performance distinctions resulting from technology differences. What is not evident from the graphic, however, is that most of the windows to the left of the 0.5-SHGC cutoff achieve a low SHGC by either a low-E coating or some form of tinted or reflective coating. Low-E windows are expected to be the predominant method of meeting the 0.5 SHGC requirement in zones one through three. This would practically eliminate the single-pane window market.

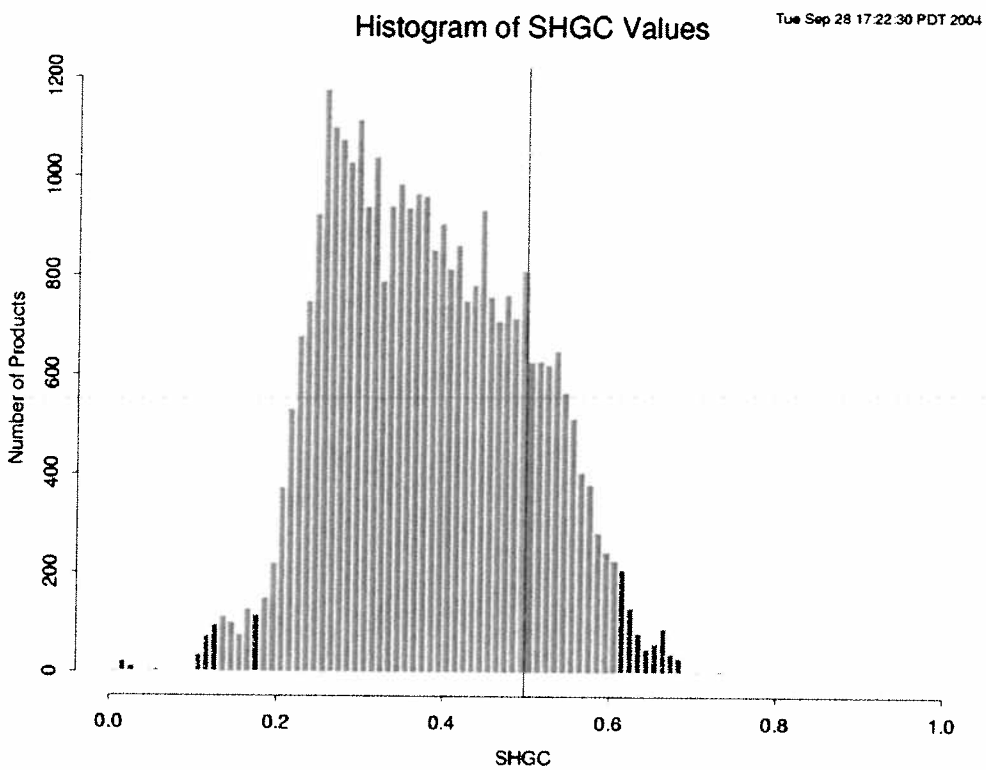

Figure 6 – Distribution of Rated SHGCs

ICYNENE CORP.

Information Taken from the Web site of the Midwest Energy Efficiency Alliance (MWEEA) (http://www.mwalliance.org)

DON'T BE FOOLED! MWEEA MEMBERSHIP & BOARD MEANS ENERGY EFFICIENCY FOR FIBERGLASS

THE BEST PROPRIETARY CODE CHANGES MONEY CAN BUY

(**June 13, 2007**) – On the Midwest Energy Efficiency Alliance's (MWEEA) Web site, the list of members and board of directors seems to be the "who's who" of public and private sector energy efficiency aficionados but don't be fooled! The fiberglass industry pays to play with the result being a key position on MWEEA's board of directors and the best proprietary code changes money can buy.

At every turn, MWEEA advocates for its fiberglass industry driven board and members to turn state and local building codes into a set of PROPRIETARY standards for fiberglass only.

AND WHO IS ON MWEEA'S BOARD?

Of its 23 Board of Directors, the following individuals are representatives of private sector fiberglass companies or from non-profits representing the fiberglass industries interest:

- Kate Offringa —North American Insulation Manufacturers Association
- Marty Kushler —American Council for an Energy Efficient Economy
- Jim Larsen —Cardinal Glass Industries
- Kara Saul Rinaldi —Alliance To Save Energy

Of its 60 members, the following members are the fiberglass companies or funded non-profits that finance MWEEA's advocacy for proprietary building code changes:

- **Alliance to Save Energy**
- **The American Council for an Energy-Efficient Economy**
- **Brickfield Burchette Ritts & Stone (*Cardinal Glass's law firm*)**
- **Cardinal Glass Industries**
- **Guardian Industries Corporation**
- **North American Insulation Manufacturers Association**

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WHEN YOU HEAR ABOUT THE MIDWEST ENERGY EFFICIENCY ALLIANCE, THINK OF EACH OF THESE GROUPS

Alliance to Save Energy (ASE)

Members of ASE include:

- ***North American Insulation Manufacturers Association (NAIMA)***
- CertainTeed
- Guardian Industries
- Johns Manville
- Knauf
- Owens Corning
- Cardinal Glass
- Midwest Energy Efficiency Alliance

American Council for an Energy Efficient Economy (ACEEE)

Members of ACEEE include:

- Alliance to Save Energy
- ***North American Insulation Manufacturers Association (NAIMA)*** CertainTeed
- Guardian Industries
- Johns Manville
- Knauf
- Owens Corning
- Cardinal Glass

Responsible Energy Code Alliance (RECA)

Members of RECA include:

- Alliance to Save Energy
- American Council for an
- Energy Efficient Economy
- ***North American Insulation Manufacturers Association (NAMA)***
- CertainTeed
- Guardian Industries
- Johns Manville
- Knauf
- Owens Corning
- Cardinal Glass

DON'T BE FOOLED! THIS IS NOT JUST ABOUT ENERGY EFFICIENCY!

THIS IS A CONCERTED EFFORT FUNDED BY *NAIMA* AND THE FIBERGLASS INDUSTRY TO INCREASE THEIR MARKET SHARE THROUGH PROPRIETARY BUILDING CODE ADVOCACY!